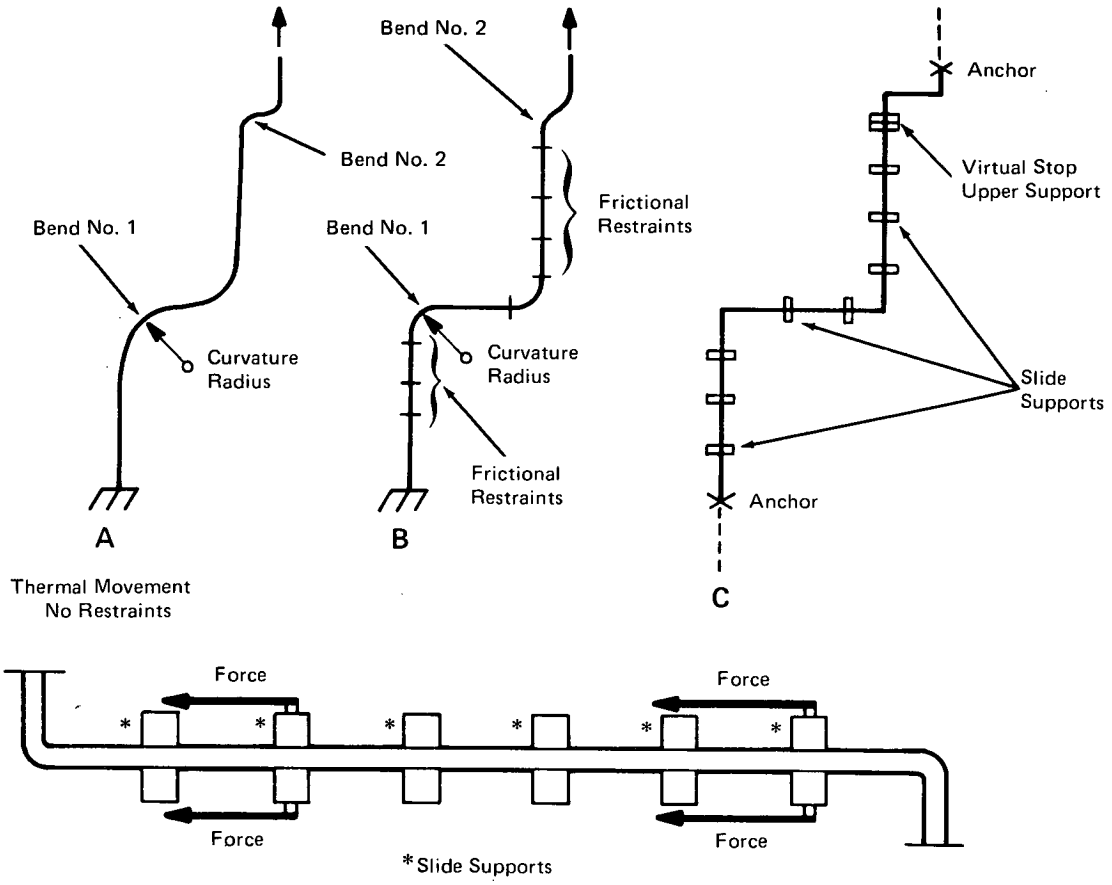
May 1972

B72-10103

NASA TECH BRIEF

Marshall Space Flight Center

Longitudinal Friction Forces in Piping Design



The problem:

Computer programs available to expedite the solution of piping analysis, and methods of reducing deformation do not consider sliding support friction forces.

The solution:

A scheme has been developed to measure longitudinal friction forces, and to incorporate them into the software programs which are used to analyze piping flexibility.

How it's done:

Friction restraint usually starts without any initial value, but develops any value up to a limit of the friction coefficient times the thrust between the sliding surfaces.

Considering a model of a "Z" bend as indicated in the diagram:

In figure A, the frictional force component does not restrain the thermal movement, the radius of curvature remaining relatively large. Bend #1 stretches about five times as much as bend #2.

(continued overleaf)

In figure B, however, due to frictional restraint, as indicated by the lines crossing the pipe, the radius of curvature of bend #1 is smaller. This results in forces which put a greater strain on bend #2.

Utilizing external restraints, whose loads were calculated from computer tables, flexibility constants were modified until the loading matched the limitation of friction. These external loads for an empty pipe line, combined with the limited flexibility of bend #2, caused a decrease in the displacement of the upper support. When the pipe line was loaded with LN_2 (Liquid Nitrogen), the resulting forces were enough to make a virtual stop at the upper support as shown in figure C.

The restraining forces were varied from 35 to 45 per cent of the weight of the support. This numerical variation was necessary to obtain the calculated results.

These results were documented in equation form, and are a necessary addition to the computer program for a more accurate analysis of piping design.

Note:

Requests for further information may be directed to:

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Reference: B72-10103

Patent status:

No patent action is contemplated by NASA.

Source: C. S. Parker of
General Electric Company
under contract to
Marshall Space Flight Center
(MFS-13754)